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# Southwest FISHERIES CENTER

HONOLULU LA JOLLA MONTEREY TIBURON

## REPORT OF ACTIVITIES September-October 1989

**ANTARCTIC ECOSYSTEM RESEARCH GROUP** Page

Preparations Are Underway for 1989-90 AMLR Field Program ..... 1

**COASTAL FISHERIES RESOURCES DIVISION**

Spanish-Portuguese SARP Meeting Held ..... 2

**FISHERY-MARINE MAMMAL INTERACTIONS DIVISION**

1989 Harbor Porpoise Survey in California Completed ..... 5

**HONOLULU LABORATORY**

NMFS Participates in Planning Meeting of Forum Fisheries Agency ..... 8

**PACIFIC FISHERIES ENVIRONMENTAL GROUP**

Mesoscale Variability Discovered in Spring Oceanographic Conditions off Central California in 1988-89 ..... 10

**PELAGIC FISHERIES RESOURCES DIVISION**

Summary of 1987 Tuna/Porpoise Observer Data Published ..... 11

**TIBURON LABORATORY**

Cruise Evaluates Use of Ship-towed Vehicle with Underwater Video Camera ..... 15

**INFORMATION TECHNOLOGY SERVICES**

SWFC Local Area Network Progress and Plans ..... 17

**EVENTS** ..... 17

**PUBLICATIONS** ..... 18

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# ANTARCTIC ECOSYSTEM RESEARCH GROUP

La Jolla, California

### Updated Research Strategy for AMLR Program Completed

The US Antarctic Marine Living Resources (AMLR) program provides information needed to formulate US policy on the conservation and international management of resources living in the oceans surrounding Antarctica. The program advises the US delegation to the Convention for the Conservation of Antarctic Marine Living Resources (CCAMLR), part of the Antarctic treaty system. One of the principal tenets of the CCAMLR treaty is that the harvest of living resources shall be managed with the goal of preserving species diversity and stability of the entire marine ecosystem.

The goal of the AMLR field program is to determine critical, ecological relationships in the Antarctic pelagic marine ecosystem, specifically between key environmental factors, prey, and predators. It is based on the working hypotheses that physical features in the pelagic ocean (such as water mass fronts, sea ice and upper layer mixing) constrain primary production and the spatial distribution of krill; that the spatial distribution of krill affects the life history parameters of land-based predator populations during the reproductive season; and that pelagic predators interact with prey in a very different manner than land-based ones.

The AMLR field research strategy is to link studies of predator feeding ecology and reproductive success with observations of krill distribution and key environmental factors. The link will be accomplished by determining how temporal and spatial patterns in the ocean's physical structure relate to spatial distribution of primary production and krill, and to the behavior and ecology of land-based and pelagic predators. Rather than attempt to assess the physical and biological components of a large region of the southern ocean, effort will be concentrated in the vicinity of Elephant Island in the South Shetland Islands.

The 1989-90 field program will focus on a 100 by 100 mile area around Elephant Island. Our objectives are to describe 1) the physical structure of the mixed layer, 2) the distribution of primary productivity, 3) the distribution of krill, and 4) the foraging patterns, reproductive success, and condition of krill predators within the study area. Two to four sampling replicates are planned over the course of the cruise (two legs, one month each). In addition, satellite imagery will be utilized to provide data on broad scale environmental features.

Proposals were solicited for projects to meet objectives not addressed by NOAA staff. NOAA will work on marine mammals and birds at Seal Island, north of Elephant Island, and study crabeater seal movements using satellite telemetry. Satellite imagery within the study area and the surrounding region will be processed by NOAA. (J. Rosenberg, FTS 893-7600)

### Preparations Are Underway for 1989-90 AMLR Field Program

The NOAA Ship *Surveyor* is currently being prepared for the upcoming 1989-90 AMLR field program (Figure 1). The *Surveyor* will leave Seattle on November 27, 1989, and make stops in San Diego, Valparaiso, and Punta Arenas. The majority of the scientific party will board the *Surveyor* in Punta Arenas to take part in Leg I of the field program from January 1 to January 30, 1990. There will be a port call in Punta Arenas from January 31 to February 3, 1990, in order to replenish supplies and make crew

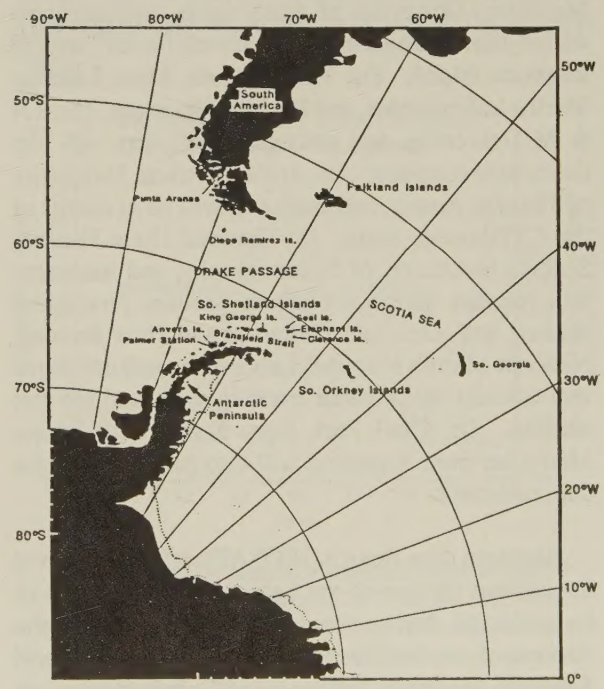


Figure 1. Antarctic cruise of the NOAA Ship *Surveyor*, 1989-90.

changes. Leg II of the field program will run February 4 to March 5, 1990. The *Surveyor* will then travel back to Seattle, making stops at Punta Arenas, Callao, and San Diego along the way, arriving in Seattle on April 16, 1990.

Leg I of the cruise will begin with the re-supplying of a field team on Seal Island. (The field team will be transported to Seal Island prior to the beginning of Leg I in order to be present at the onset of the reproductive season of penguins and seals.)

The field program includes four replicate 7-day surveys that will be broken up by other studies. Each 7-day survey will include hydroacoustic studies of krill, direct krill sampling, CTD/rosette casts, and phytoplankton/primary production studies. Following the re-supplying of the Seal Island shore camp, the first 7-day survey will begin. The first survey will be followed by a 9-day predator (fur seal and penguin) tracking study, and then the second 7-day survey. After the port call in Punta Arenas, Leg II will begin with the third 7-day survey, followed by ice seal studies, and then the last 7-day survey. Leg II will conclude with the recovery of the Seal Island field team.

Drs. Roger Hewitt and Rennie Holt of the Southwest Fisheries Center will be cruise leaders on Legs I and II of the cruise, respectively. Dr. Michael Macaulay, University of Washington, and assistants will conduct the hydroacoustic survey for krill around Elephant Island; Dr. Valerie Loeb, Moss Landing Marine Laboratories, and Dr. John Wormuth, Texas A & M University, and assistants will carry out the direct krill sampling; Dr. Anthony Amos, University of Texas at Austin, and assistants will be in charge of the CTD/rosette casts; Dr. Osmund Holm-Hansen, Scripps Institution of Oceanography, and assistants will conduct the phytoplankton/primary production studies; and Drs. John Bengtson and Peter Boveng, National Marine Mammal Laboratory, and assistants will conduct the predator tracking study and ice seal studies. Dr. Chul Park from Korea and Adrian Madirolas from Argentina will also participate in the data collection.

Seabeam data along a GEOSAT trackline and over the eastern portion of the Sala y Gomez Ridge will be collected during the southbound transit of the *Surveyor* from San Diego to Valparaiso by Dr. David Sandwell of Scripps Institution of Oceanography and assistant.

In addition, Seabeam bathymetric data will be collected by Dr. Lawrence Lawver, University of Texas at Austin, and assistants during Legs I and II. Tissue samples from mysticete whales will be collected during Legs I and II by Dr. Scott Baker of the National Cancer Institute and Dr. Gregory Stone of NOAA, National Undersea Research Program, and assistants.

Also, three sediment cores from the Peruvian continental shelf will be obtained during the northbound transit of the *Surveyor* by Dr. Thomas DeVries, University of South Carolina, and assistants. There will also be bird observations conducted on this transect by Craig Strong and Debra Jacques of Point Reyes Bird Observatory. (J. Rosenberg, FTS 893-7600)

## COASTAL FISHERIES RESOURCES DIVISION

La Jolla, California

### Spanish-Portuguese SARP Meeting Held

Dr. Paul Smith convened two groups involving 36 scientists at a recent Spanish-Portuguese SARP Meeting to consider the Spanish-Portuguese Sardine Anchovy Recruitment Program (SARP) over the past 3 years, and other SARP projects and plans. Countries represented were Argentina, Brazil, Chile, France, Germany, Japan, Mexico, Portugal, Spain, UK, US, and the USSR. This was the final meeting of a 3-year project on *Sardina pilchardus*, along the Atlantic coastline of Spain and Portugal. The projects were carried out by the Spanish Institute of Oceanography and the Portuguese National Institute of Fisheries Science with the cooperation of the Coastal Division of the SWFC. The projects included determining adult reproduction parameters, egg production values in the sea, physical oceanography of the area, regionality and seasonality of spawning, and the birthdate distribution of juveniles found in the autumn. Products of this work were a comparison of the egg production method, the acoustic-trawl method and the tuned virtual population analysis for estimation of the stock spawning biomass. One of the most startling findings was that a parasitic dinoflagellate on the eggs of the winter spawners off Portugal resulted in massive mortality of eggs on hatching because the yolk had been consumed as the parasite reproduced. The Spanish scientists will continue work on egg production and birthdate distribution,

and will add new work on larval ecology. Paul Smith, Alberto Garcia of Spain, and M. Emilia Cunha of Portugal are assembling the final text and data report for 3 years' Spanish SARP research.

The other meeting was sponsored by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Education, Scientific and Cultural Organization. Dr. Juergen Alheit, head of the Ocean Sciences for Living Resources (OSLR) program, chaired the ad hoc Expert Consultation on SARP. The results of this meeting will be used for the statutory meeting of IOC-OSLR next year for planning purposes. Of particular interest were the reports of the multi-disciplinary work on the anchovy of the southwest Atlantic, the sprat of the North Sea, and the Satellite Ocean Analysis for Recruitment (SOAR). (P. Smith, FTS 893-7169)

## COASTAL EASTERN PACIFIC FISHERIES ENVIRONMENTAL INVESTIGATIONS

### Satellite Image Processing

The capability for processing satellite images at the Southwest Fisheries Center is rapidly becoming a reality. All the data processing hardware is in place and the software installed.

PC-SEAPAK is a user-interactive satellite data analysis package developed at NASA/Goddard Space Flight Center which is designed for processing and interpretation of the Nimbus-7/Coastal Zone Color Scanner(CZCS) and the NOAA Advanced Very High Resolution Radiometer (AVHRR).

Processing of CZCS images begins with a software video Browse utility designed to provide a researcher with the ability to quickly search the entire CZCS data set and to view the scenes that meet the search criteria. Scenes can then be ordered through the NASA archive, where the digital data are copied and sent to the requester. In the near future, AVHRR images will be available in a similar manner.

SEAPAK has the capability to ingest CZCS or AVHRR images recorded in the NASA/Goddard data format, from 9-track tape or floppy disk. Once the data images are in the computer there are numerous processes used to calibrate, register, pseudo-color, and display the enhanced image on a high resolution monitor. A fully operational system should be in place in the very near future. (K. Bliss, FTS 893-7082)

## ECOLOGY AND SYSTEMATICS OF FISHES (CalCOFI)

### Distribution and Abundance of Early Life History Stages of the California Halibut, *Paralichthys californicus*

Dr. H. G. Moser and Fishery Biologist W. Watson have investigated the temporal and spatial abundance patterns of the larvae of two paralichthyid flatfishes, California halibut (*Paralichthys californicus*) and fantail sole (*Xystreurys liolepis*). Moser and Watson used a 30-year-long (1951-1981) CalCOFI data set that included stations from central California to southern Baja California, and an 8-year-long (1978-1986) nearshore data set from two sites in the vicinity of San Onofre, California.

California halibut spawn throughout the year, primarily in February and March and secondarily between July and October off California and northern Baja California. Further south, in Sebastian Viscaino Bay and off central and southern Baja California, spawning is primarily between June and August, and secondarily in February and March. Larvae occur primarily over the continental shelf, in the upper 30 m of the water column. Postflexion larvae are concentrated nearer the surface than the younger larvae; the oldest larvae occur almost exclusively very near shore in the neuston. The upward movement of older larvae may facilitate their movement to the shallow zone where they settle and transform to the juvenile stage.

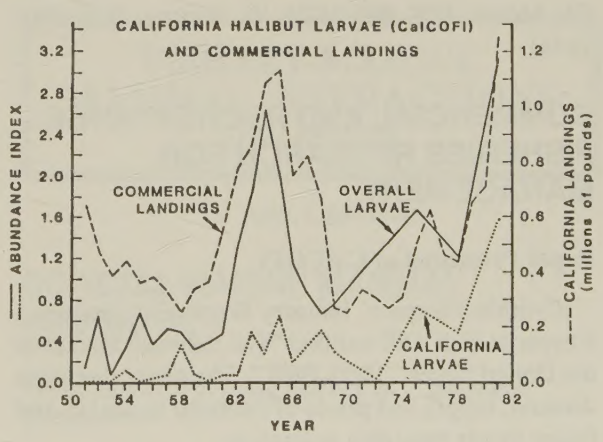


Figure 1. ANOVA annual abundance index values for larval *Paralichthys californicus* from all 1951-1981 CalCOFI stations and from the California stations alone, and 1951-1981 annual California commercial landings of *P. californicus* (from Moser and Watson, in press).

Abundance of larval California halibut is highest off southern California, northern Baja California, and in Sebastian Viscaino Bay, and lowest off central California and southern Baja California. Interannual patterns of larval abundance and the California commercial catch have been highly concordant since 1958, suggesting that the year-to-year fluctuations in the commercial catch result largely from changes in halibut abundance (Figure 1). Furthermore, this concordance of interannual patterns suggests that ichthyoplankton surveys can be used as a fishery-independent tool to assess and monitor the spawning biomass of California halibut.

Fantail sole spawn throughout the year, with most activity in the last half of the year (August-December). Larvae occur primarily over the continental shelf, mainly off Baja California. Preflexion and flexion larvae occur principally in the midwater column; postflexion larvae settle into the moderately shallow (22-45 m) epibenthos where they transform to the juvenile stage. The very different benthic recruitment strategies of fantail sole and California halibut preclude trophic competition between the young juveniles of the two species.

The initial results of this study were presented at a symposium on the California halibut sponsored by the California Department of Fish and Game, held at Cabrillo Museum, San Pedro, California, May 22-25, 1989. A final version of this paper was given at this year's annual CalCOFI meeting. The paper will be published in the Halibut Symposium volume, which will be a dedicated issue of the CDF&G Fish Bulletin. (H. Moser, FTS 893-7129; W. Watson, FTS 893-7144)

## COMMERCIAL AND RECREATIONAL FISHERIES RESEARCH FOR MANAGEMENT

### Paper Presented at CalCOFI

Cynthia Thomson, Industry Economist, presented a paper at CalCOFI entitled "The fishmeal market in the United States: 1960-1988." The paper discusses demand, supply and prices of fishmeal in the US and future trends regarding utilization.

High-protein oilmeals, like fishmeal, are traded in a very competitive international market. The soybean meal price is generally considered to be a leading indicator for major oilmeal prices. Figure 2 illustrates the high correlation between soybean meal and fishmeal prices in the US. The price differential is due largely to differences in protein content (50% for soybean meal and 65% for menhaden meal).

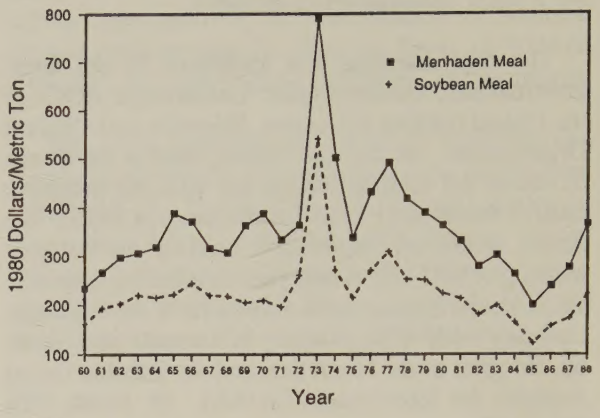


Figure 2. US fishmeal and soybean meal prices: 1960-1988 (1980 dollars/metric ton).

The dramatic price increase in 1973 was due to an unprecedented worldwide shortage of oilmeals. Several factors contributed to this shortage, including 1) major failures of oilmeal crops around the world, 2) increases in fuel-related production costs resulting from the Arab oil embargo, and 3) the collapse of the Peruvian anchoveta fishery.

Although the collapse of the anchoveta fishery coincided with the 1972-73 El Niño, an FAO panel of experts later concluded that overfishing had been occurring for a number of years and that "the El Niño...apparently only served to accelerate a collapse that was already in progress." Until 1973, Peru provided 50%-65% of the fishmeal traded in international markets. The collapse of the anchoveta fishery had a profound effect on fishmeal supplies in many countries, including the US.

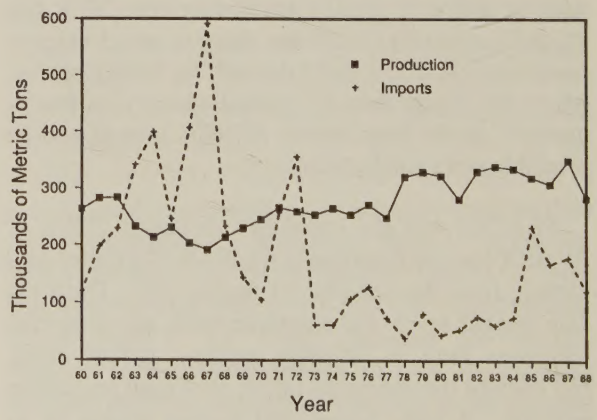


Figure 3. US production and imports of fishmeal: 1960-1988 (thousands of metric tons).

Over the years the US has relied on imports as well as domestic production to meet the demand for fishmeal. Year-to-year changes in domestic production have been fairly modest, while imported supplies have fluctuated widely (Figure 3). Imports dropped dramatically after the collapse of the Peruvian anchoveta fishery and did not begin increasing again until the mid-1980's.

Fishmeal is used in the US largely as a high-protein ingredient in poultry feed. Since 1960, US demand for poultry has quadrupled, due to increases in both per capita consumption and population. The poultry industry has been able to accommodate this increase in demand with a limited supply of fishmeal by using a variety of strategies:

1. Poultry feed mixers have reduced the use of fishmeal to minimal levels in starter rations and have eliminated it altogether from grower/finisher rations for chickens and turkeys. They have accomplished this by substituting more plentiful ingredients, such as soybean meal. When properly supplemented, soybean meal mixes are nutritionally equivalent to fishmeal mixes.

2. Technological changes in poultry production have reduced the time to market for a 3-pound broiler from 9 weeks in 1960 to 6 weeks today. This has significantly reduced feed requirements (including fishmeal) per pound of final product.

The paper also discusses future trends regarding the use of fishmeal:

1. Fishes that are currently used in fishmeal production may be increasingly diverted to direct human consumption. Experimental efforts to make surimi from menhaden and to test-market canned Pacific sardine for human consumption, are currently underway. Depending on the success of these efforts, fishmeal producers may be looking elsewhere in the marine food chain for raw materials for fishmeal production.

2. Aquaculture production in the US almost tripled between 1980 and 1985, and is expected to continue increasing. Given that fishmeal is used as a feed ingredient for farm-raised fish as well as for poultry, we can expect to see increasing demand for fishmeal in aquaculture. (C. Thomson, FTS 893-7116)

### Analysis of Options for Amending the Anchovy Fisheries Management Plan

The Anchovy Fishery Management Plan Development Team, consisting of Larry Jacobson, Cynthia Thomson and Rick Klingbeil (CDF&G), met with the Pacific Fishery Management Council's (PFMC) Anchovy Advisory Subpanel on October 13 to discuss a preliminary analysis of options for amending the Anchovy FMP to provide a small reduction fishery at low levels of spawning biomass. The Subpanel's comments were incorporated into the analysis and results have been written by Jacobson and Thomson in the form of a paper to be discussed by the PFMC at its meeting in Portland, Oregon in November. The analysis is based on a bio-economic simulation model developed by Jacobson and Thomson. In the course of parameterizing the model, a revised estimate of MSY (219,000 mt at a total biomass level of 586,000 mt) was obtained.

Recently revised NOAA guidelines for fisheries management plans stipulate that each FMP must include a definition of overfishing. A proposed definition of overfishing for anchovy has been developed by the Anchovy FMP Development Team and was discussed at the meeting with the Anchovy Advisory Subpanel on October 13. A paper describing the proposed definition has been prepared by Klingbeil with the help of Jacobson and Thomson for use by the PFMC at its meeting in November. (L. Jacobson, FTS 893-7117)

## FISHERY-MARINE MAMMAL INTERACTIONS DIVISION

La Jolla, California

## COASTAL MARINE MAMMAL PROGRAM

### 1989 Harbor Porpoise Survey in California Completed

The autumn 1989 aerial survey for harbor porpoise in California was begun in August and completed in October. This was the fourth in a series of line-transect surveys designed to detect changes in porpoise abundance. Since the mid-1970s, some harbor porpoise have died each year in halibut gillnets. The last

reliable estimates were 200-300 per year in 1983-86. Although the number killed is thought to have declined since 1986, it is difficult to determine whether continued gillnet mortality has been causing further reductions in the harbor porpoise population. The surveys were originally initiated to directly assess the impact of gillnet mortality on the populations by monitoring population size over several years. Since 1986, the California Department of Fish and Game (lead by Doyle Hanan, Program Leader) and the SWFC (lead by Jay Barlow, Research Analyst), have been collaborating on annual surveys of harbor porpoise in central California.

The surveys are conducted from a twin-engine Partenavia aircraft chartered for that purpose. Typically, the airplane flew at 700 feet along a predefined course that zigzags between the coast and the 50-fathom depth contour (Figure 1). Two observers search laterally out the left and right side windows, while a third observer looks vertically through a belly-port window. An additional person records sighting and effort information on a lap-top computer. An attempt has been made to repeat each of the 26 standard transects five to seven times each year. In addition to these standard transects in central California, 18 transects in northern California were surveyed in 1989. Surveys of the northern California region were repeated three times this year. The abundance of harbor porpoise in this area had not been surveyed since 1985.

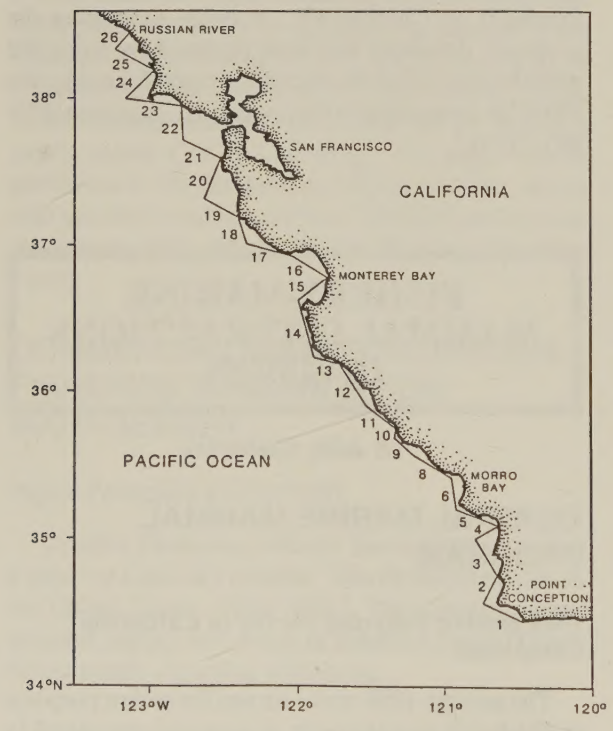


Figure 1. Transect lines used in the 1986-89 surveys of harbor porpoise in central California. Transect 7 was combined with transect 8 starting in 1987 and is not shown.

Analysis of the 1989 surveys will be completed during the next several months, however, some preliminary information is available. A total of 5,158 km was surveyed this year resulting in sightings of an estimated 279 porpoises. Of these, 3,764 km and 181 porpoises were on the standard 26 transect lines that had been surveyed in each of the three preceding years. The number of porpoise seen per km of survey effort has been used as an index of harbor porpoise abundance. This index is affected by sighting conditions. Only sightings made during good survey conditions are included when making comparisons between years and areas. These stratified estimates for 1986, 1987, 1988, and 1989 are 0.084, 0.038, 0.045, and 0.088 porpoise/km, respectively. The relatively large interannual variation in porpoise density seen in these rough density indices indicate that it might be difficult to detect long-term trends in porpoise abundance. Karin Forney (Computer Programmer, SWFC) is investigating additional methods of stratifying the data by area and sighting conditions to reduce the amount of random error in the indices of abundance. Preliminary results indicate that we should be able to detect large, monotonic increases or decreases of approximately 50% after 6 years of survey effort.

Based on 1989 results, comparisons of average porpoise density between central California (0.088 porpoise/km) and northern California (0.149 porpoise/km) show that porpoise occur at nearly twice the density in northern California. This higher porpoise density in northern California was expected given results of 1984-85 ship and aerial surveys. In fact, the previous ship surveys suggested that the density of porpoise in northern California was five times the highest density estimated for central California. With additional research, scientists may be able to resolve whether the 2-fold vs. 5-fold difference in relative abundance is due to sampling error or whether it can be attributed to actual changes in relative porpoise utilization of these two areas. (J. Barlow, FTS 893-7178)

## BIOLOGY ASSESSMENT PROGRAM

### Life History Parameters of ETP Dolphin Species Examined as Potential Indices of Population Condition

In a continuing effort to correlate biological parameters with the growth or decline of a population, the Biology Assessment Program has examined data collected from four eastern tropical Pacific (ETP) dolphin species. The four species are the spotted dolphin (*Stenella attenuata*), spinner dolphin (*S. longirostris*), common dolphin (*Delphinus delphis*), and streaker dolphin (*S. coeruleoalba*). Each of these species is incidentally killed in the yellowfin tuna purse-seine fishery but at different rates. Available population size indices for the offshore stock of spotted dolphin and two stocks of spinner dolphins (the eastern spinner and the northern whitebelly spinner) indicate that a significant decline in number has occurred since the fishery began in 1959. Comparable estimates for the common dolphin and the streaker dolphin populations indicate much lower rates of exploitation.

The survival and fecundity rates for each of these four ETP dolphin species are expected to have changed as their numbers declined. Although for long-lived mammalian populations, survival rates for the young-of-the-year and juveniles are predicted to exhibit change in a declining population before reproductive rates, survival rates are not directly measurable for ETP dolphin species. Thus, the potential for utilizing measurable life history parameters to predict population condition for these species is likely to be limited to the examination of reproductive rates.

To date we have analyzed the fraction of mature females that are pregnant, lactating, simultaneously pregnant and lactating, and resting (Table 1). In addition to calculating these fractions for each of the species and the two stocks of spinner dolphins, the data collected since 1974 were analyzed for statistically significant temporal trends.

Although the fraction of mature females in each reproductive state is not directly comparable between the species, there are similarities and differences which may correlate to their relative degree of exploitation. The proportion of mature females that were pregnant in each stock and species was not significantly different, however, the proportion of mature females that were either lactating, simultaneously pregnant and lactating, or resting was significantly different ($p<0.01$, $p<0.001$ and $p<0.001$, respectively). While the interpretation of differences in the proportion of the population that is lactating or resting is difficult, the simultaneously pregnant and lactating reproductive condition is proposed in the literature as a good indicator of changes in population size relative to carrying capacity. For example, the percent of mature females that are simultaneously pregnant and lactating is thought to increase as a population moves away from its carrying capacity. Currently, we are testing for trends in this pattern that we can correlate with trends in relative abundance.

Table 1. Proportion of females in each reproductive condition by species. The calculation of proportion mature includes all females of known maturity state, whereas the proportions by reproductive state are for mature females only. Specimens were collected by technicians aboard US purse-seiners in the eastern tropical Pacific.

| Species | Mature | Pregnant | Lactating | Pregnant & lactating | Resting |
|---|---|---|---|---|---|
| Spotted | 0.652 | 0.299 | 0.472 | 0.062 | 0.156 |
| Spinner | | | | | |
| Eastern | 0.468 | 0.314 | 0.501 | 0.025 | 0.142 |
| Whitebelly | 0.580 | 0.293 | 0.423 | 0.031 | 0.234 |
| Common | 0.574 | 0.294 | 0.453 | 0.136 | 0.094 |
| Streaker | 0.495 | 0.340 | 0.298 | 0.064 | 0.234 |

The most heavily exploited stocks, the northern offshore spotted dolphin, the eastern spinner dolphin, and the northern whitebelly spinner dolphin, exhibit the lowest proportion of mature females simultaneously pregnant and lactating (Table 1). These proportions are lower than might be expected for stocks estimated to be below carrying capacity.

Examination of the available data for temporal trends has revealed that the proportion of simultaneously pregnant and lactating and resting females has significantly increased for common dolphins since 1974 (p). For the spotted and spinner stocks examined, a statistically significant decreasing trend in the proportion of mature females present in the population was found, but there were no temporal trends by reproductive condition. Insufficient data are available to analyze temporal trends for streaker dolphins. Further analyses are being conducted to determine the effects of geographic location and season. (S. Chivers, FTS 893-7093)

# HONOLULU LABORATORY

Honolulu, Hawaii

### NMFS Participates in Planning Meeting of Forum Fisheries Agency

The National Marine Fisheries Service (NMFS) was represented at the Third Technical Subcommittee Meeting of the Forum Fisheries Committee in Honiara, Solomon Islands, in September 1989, by Honolulu Laboratory Director George W. Boehlert. This meeting, entitled "A Conference on the Management and Development Strategies in South Pacific Fisheries," was called in honor of the 10th anniversary of the Forum Fisheries Agency (FFA). The goals of the meeting were to review the first 10 years of progress by the FFA and to develop a work plan for the coming decade. The meeting was attended by fisheries officers or ministers of all member countries; observers came from a variety of regional and international research organizations, donor agencies, and universities.

A variety of papers was presented at the week-long meeting: a review of FFA activities for the last decade, an overview of financial aid patterns, policy and activity reports from agencies within and outside the region, and different interpretations of trends in fisheries research, economics, management, and law of the 1990's as they relate to the South Pacific. Boehlert presented two NMFS working papers, one on US fisheries research activities within the Pacific and another on fisheries research in the 1990's.

The papers served as background for subgroup meetings on management, development, legal, research, and economic aspects of South Pacific fisheries. Each group was charged with making recommendations on the objectives and work of FFA in the coming decade and prioritizing the recommendations. Final reports by the chairs of the subgroups to the plenary session were discussed and used to draft a "Corporate Plan," which would serve as a guidepost for FFA activities over the next decade. The final plan was to be reviewed and approved by the meeting of ministers the following week.

The FFA has been successful in assisting Pacific island nations in developing fisheries and in group negotiations with larger, deepwater fishing nations. Their corporate plan presents an ambitious effort to continue and expand their activities over the next decade. (G. Boehlert (808) 943-1211)

# FISHERY MANAGEMENT RESEARCH PROGRAM

### Fisheries Symposium in Oman

The Sultanate of Oman's International Symposium on Agriculture and Fisheries Development, held on October 15-19, 1989, at the Sultan Qaboos University in Oman, was attended by Industry Economist Samuel G. Pooley and former Laboratory Director Richard S. Shomura. The symposium was called to initiate the Sultanate's fourth 5-year plan (1990-94) by identifying obstacles and constraints facing the agricultural and fisheries sectors, to diagnose their causes, and propose solutions.

At the symposium, Pooley gave a presentation on "The Role of Government Planning and Economic Analysis in the Development of the Private Fisheries Sector," and Shomura spoke on "The Use of Information from Research Programmes and Commercial Operations in Management and Development Decision Making: National and International Experiences."

The fisheries portion of the symposium had 50 participants and 19 invited papers, all in English. Papers in the fisheries section ranged from "Integrated Planning for Fishing Fleets, Manpower, Harbour and Other Infrastructure" to "Assessment and Management Consideration of Kingfish and Small Tunas" to "Traditional Skills, Use Rights and Community Organization." Participants in the fisheries section included Omani members of the Directorate of Fisheries, expatriate advisers, invited foreign speakers from both the western and Arab countries, and several members of the Omani private fisheries sector. In the agriculture and water resources sections, most papers were in Arabic. Publication of the proceedings is expected.

Pooley's and Shomura's participation was funded by the Omani-American Joint Commission, which administers the US Agency for International Development assistance in Oman. (S. Pooley (808) 943-1216)

### Continued Development of Fishery-Interaction Economic Models

Walter Miklius, Professor of Economics at the University of Hawaii (UH) Department of Economics, and Ping Sun Leung, Research Associate with the UH Department of Agricultural and Resource Economics, began work in October 1989 within the SWFC-wide economics program on the transporta-

tion and location analysis applied to the problem of vessels "switching" between fisheries and areas.

Typical bioeconomic models of fisheries management involve single fishery complexes, but in a number of cases, fishing vessels transfer from one type of fishery to another and from one fishing area to another, either within a year or between years. While the economic rationale for switching fisheries is simple (higher net profitability), the analysis and description of the conditions affecting this choice are not. Transportation and location analysis uses a number of network techniques to investigate such issues.

Miklius and Leung have begun reviewing previous Honolulu Laboratory research that used linear programming optimization models to examine the problem of switching fisheries or areas. Their review may lead to improved specification of the economic basis for fishery choice in these models, or they may return to more traditional models and incorporate location parameters in those models.

In the meantime, Laurel Kasaoka, Research Assistant with the Honolulu Laboratory, has revised the Laboratory's existing linear programming models to include new variations of fleets and species to better reflect the switching problem. The models are being tested to develop baseline values from which simulations of changes in basic fishery parameters will be examined. (S. Pooley (808) 943-1216)

**Small Boat Survey Design Study Completed**

The Technical Advisory Committee of the Western Pacific Regional Fishery Management Council's Small Boat Fishing Survey Design Project held its final meeting on September 21, 1989. The survey, designed to provide estimates of recreational and small-scale commercial landings of offshore fish species in Hawaii, will be fielded by the Hawaii Division of Aquatic Resources.

The study was performed by a private firm that, under contract to the Council, reviewed existing data and data collection methodologies in Hawaii, used substantial time-series analyses of existing data performed by the Honolulu Laboratory, and pretested a number of survey instruments. The study began several years ago in response to the NMFS decision not to continue fielding the Marine Recreational Fishing Statistical Survey in the western Pacific. (The NMFS survey is an almost nationwide creel survey of saltwater recreational fishing.)

The committee, chaired by Industry Economist Samuel G. Pooley, recommended that the final report on the survey design not be circulated to the general public because of proposed revisions to the sampling methodology and reservations about the report's descriptions of the existing fisheries and fisheries data systems. David C. Hamm, Computer Systems Analyst with the Honolulu Laboratory, prepared a revised sampling methodology which has been given to the Hawaii Division of Aquatic Resources for consideration in its fielding of the survey. The survey will be a 1-year sampling of major boat harbors and launching sites on Oahu. (S. Pooley (808) 943-1216)

**Training Begins for Conversion to Next Generation WPACFIN Environment**

David Hamm, Program Manager of the Western Pacific Fishery Information Network (WPACFIN), traveled to Pago Pago, American Samoa, in September 1989, to begin the basic computer training of the Department of Marine and Wildlife Resources (DMWR) staff to ready them for converting from the Apple II systems to the "next generation" WPACFIN IBM-compatible environment. The major goal of this on-site training was to familiarize as much of the DMWR staff as possible with the basic hardware and its disk operating system software to ready them for participation in an intensive computer training workshop to be held at the Honolulu Laboratory in November.

Five IBM-compatible computers were used during the training, and 14 employees attended the 3-day course. Attendees included the DMWR's deputy director, the budget and planning officer, four of the main data collectors and processors, four staff members from the wildlife section, three fisheries technicians, and Gordon Yamasaki, Fishery Biologist with the NMFS Southwest Region.

Seven DMWR staff members will be attending the 2-week training workshop in Honolulu during November, as will several personnel from the fisheries offices in the Commonwealth of the Northern Mariana Islands, Guam, and Kosrae. The major emphasis of the Honolulu workshop will be fisheries applications and the new WPACFIN dBASE IV processing environment. (D. Hamm (808) 943- 1241)

# PACIFIC FISHERIES ENVIRONMENTAL GROUP

Monterey, California

## PHYSICAL OCEANOGRAPHY

### Mesoscale Variability Discovered in Spring Oceanographic Conditions off Central California, 1988-89

PFEG Oceanographers David Husby and Frank Schwing presented preliminary results of analyses of 1988 and 1989 Tiburon Laboratory groundfish CTD surveys between Pt. Reyes and Pt. Sur, at the 36th Eastern Pacific Oceanic Conference at the Asilomar Conference Center, Pacific Grove, California, November 1-3, 1989. Horizontal distributions of near surface temperature for the three quasi-synoptic surveys of the area during the April-May 1989 cruise revealed considerable mesoscale eddy-like variability on the scale of the sampling grid, and temporal variability over the sampling interval of about 10 days (Figure 1). The major features observed in these distributions were: 1) the presence of cold, upwelled water over the broad shelf in the vicinity of Pt. Reyes, hypothesized to be advected from the north, 2) a frontal zone in the Gulf of Farallones due to the San Francisco Bay effluent, and 3) the persistence of an upwelling center off the Pescadero-Pt. Davenport region, associated with the narrow shelf. The cold, high salinity water upwelled off Davenport appears to advect southward into Monterey Bay at times.

The series of vertical sections of sigma-t along a transect off Davenport (Figure 2) reveals the importance of wind forcing on the mass distribution. The upwelling-favorable winds observed at data buoys off Half Moon Bay and Monterey during the first two phases of the survey are reflected in the upward vertical movement of the thermocline and the surfacing of the 25.8-26.0 isopycnals. The relaxation and reversal of the winds at the start of the third survey resulted in the onshore movement of warm low salinity water, intensifying the frontal zone near the coast. The area covered by water warmer than 13°C advanced northward and closer to the coast during the period of relaxed winds.

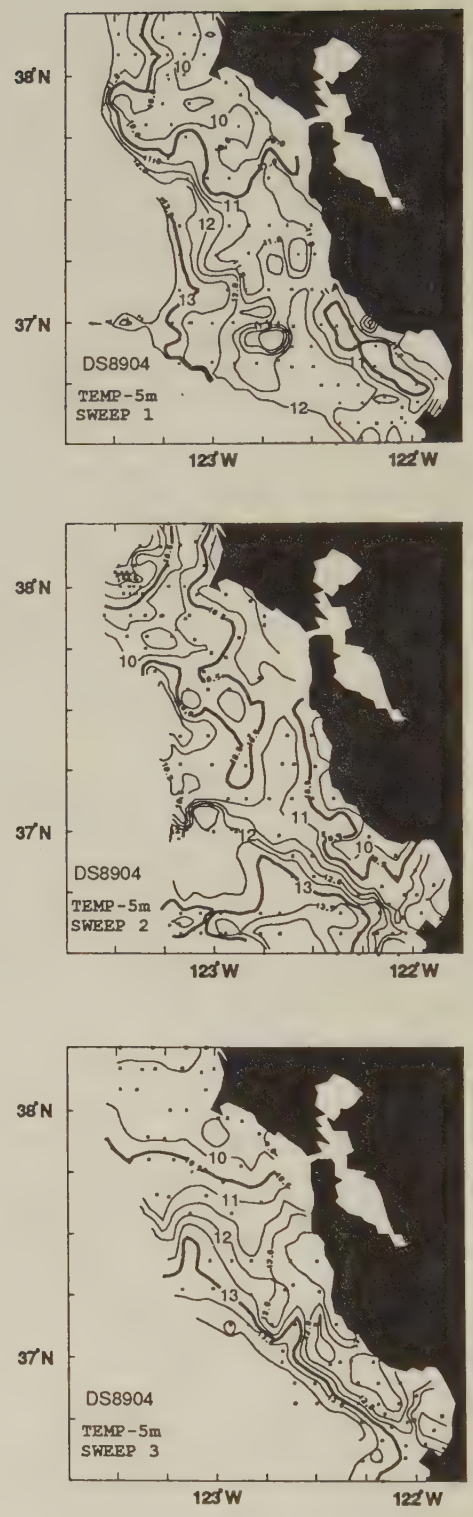


Figure 1. Temperature at 5 meters depth from CTD data of sweep 1 (May 14-22, 1989), sweep 2 (May 22-June 3, 1989) and sweep 3 (June 4-13, 1989). Bold contour lines highlight the 10.5 and 13.0°C isotherms. The contour interval is 0.5°C.

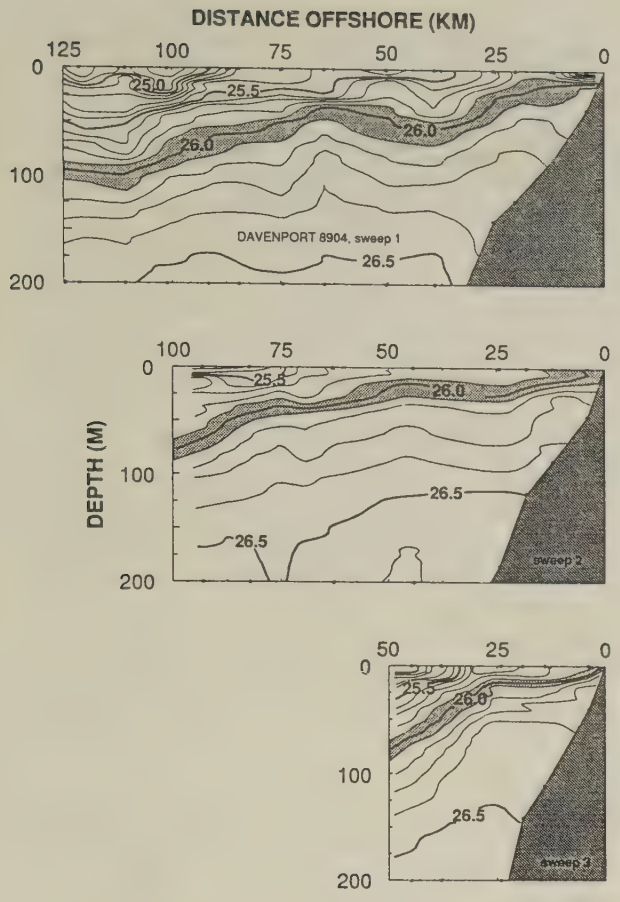


Figure 2. Vertical sections of density (sigma-t) along a transect off Davenport, CA (37°N) during the three phases of the May 14-June 13, 1989 survey. The area between the 25.9 and 26.1 isopycnals is shaded in the three panels. The contour interval is 0.1 sigma-t units.

Future work involves processing all previous CTD surveys (1987- 1989) and production of an atlas of oceanographic conditions during the groundfish surveys, emphasizing the spatial and temporal variability in the circulation in this region. These observations will be compared to meteorological records and other physical data collected independently during this time, as well as with results from the larval and juvenile groundfish sampling program. Analytical and numerical models will be used to explain some of the features seen in the hydrography. Of particular interest will be the interaction between the flow and topographic features, such as Cordell Bank. It is believed that the proper combination of bathymetry and hydrographic structure may greatly enhance the aggregation of larval and juvenile fish, or their prey. (D. Husby and F. Schwing (408) 646-3311)

# PELAGIC FISHERIES RESOURCES DIVISION

La Jolla, California

## MULTISPECIES DATA COLLECTION AND EVALUATION PROGRAM

### South Pacific Tuna Treaty Data Submitted to Forum Fisheries Agency

As required under the South Pacific Tuna Treaty, data collected from US purse seiners fishing in the Treaty area during August 1, 1989 to October 1, 1989, were submitted to the Forum Fisheries Agency, by Doug Prescott, Computer Programmer. The submission consisted of 16 catch report forms, 209 length-frequency samples (93 yellowfin, 64 skipjack and 52 bigeye), and 111 unloading forms.

Data collected for the first year of the treaty, June 1988 to June 1989, are being summarized by Al Coan, Mathematical Statistician, and Prescott. Preliminary results show approximately 130,200 short tons (st) of tuna (109,700 st skipjack and 20,500 st of mixed yellowfin and bigeye) were landed by 32 US purse seiners in approximately 138 separate landings. The majority of the landings were made in American Samoa, and some direct landings or transshipments were made in Puerto Rico (1,853 st), Japan (824 st), Indonesia (719 st), Thailand (311 st), Philippines (183 st) and Australia (107 st). High catches of over 10,000 st per month were made in July 1988 and January, March and June 1989. The majority of the skipjack caught were between 50 to 60 cm long, and yellowfin and bigeye tunas between 45 and 75 cm long. Species composition samples indicate that approximately 5,500 st of bigeye tuna (27%) are included in the 20,500 st of mixed landings of yellowfin-bigeye. (A. Coan, FTS 893-7079; D. Prescott, FTS 893-7080)

### Summary of 1987 Tuna/Porpoise Observer Data Published

Dolphin mortality rates in 1987, as measured by dolphin kill-per-set and kill-per-ton of yellowfin tuna caught, were down considerably from 1986 levels, according to data collected by observers aboard US tuna purse seiners and summarized by Biological Technician Al Jackson in NOAA Technical Memorandum "Summary of the 1987 US tuna/porpoise observer data" (NOAA-TM- NMFS-SWFC-136) issued

in October. In 1987, an average of 3.11 dolphins were killed in each dolphin set and an average of 0.18 dolphin was killed per short ton of yellowfin tuna caught in these sets. In 1986, the dolphin kill-per-set and kill-per-ton rates stood much higher at 7.21 and 0.29. When examined on a yearly basis since 1981, there appears to be a trend toward a lower kill-per-ton rate, but no such trend is apparent for the kill-per-set rate (Figures 1A, B).

Figure 1. Kill rates for observed US tuna purse seiners in the eastern tropical Pacific Ocean from 1981 to 1987.

A total of 13,382 dolphins was killed by the observed US fleet in 1987 (Table 1). Of this, 13,345 were killed in intentional dolphin sets and 37 in accidental dolphin sets. The dolphin population sustaining the most mortalities was the offshore spotted dolphin (8,436 mortalities), followed by the eastern spinner dolphin (2,557), the whitebelly spinner dolphin (981) and the common dolphin (882).

Table 1. Dolphins killed by observed US tuna purse seiners in the eastern tropical Pacific Ocean, 1987. (Includes kill resulting from 4,294 intentional and 17 accidental dolphin sets.)

| | Number of dolphins killed | | | |
|---|---|---|---|---|
| Species/Stock | Male | Female | ?-Sex | Total |
| Offshore spotted dolphin | 1,413 | 1,763 | 5,260 | 8,436 |
| Eastern spinner dolphin | 565 | 490 | 1,502 | 2,557 |
| Whitebelly spinner dolphin | 198 | 194 | 589 | 981 |
| Common dolphin | 149 | 224 | 509 | 882 |
| Unidentified dolphin | 0 | 0 | 389 | 389 |
| Unidentified spinner dolphin | 8 | 11 | 36 | 55 |
| Bottlenose dolphin | 9 | 11 | 32 | 52 |
| Rough-toothed dolphin | 4 | 8 | 4 | 16 |
| Striped dolphin | 5 | 0 | 3 | 8 |
| Pacific white-sided dolphin | 0 | 2 | 3 | 5 |
| Unidentified spotted dolphin | 0 | 0 | 1 | 1 |
| Total | 2,351 | 2,703 | 8,328 | 13,382 |

Of the 4,294 observed intentional dolphin sets, 2,659 sets (or 61.9% of the total) resulted in no dolphin kills, and 184 (4.3% of the total) were sets in which more than 15 dolphins were killed, often referred to as "problem sets". This compares favorably to 1981-86 when no-kill sets accounted for 59.8% of the total, and problem sets accounted for 6.1%. The greatest number of dolphins killed in a single set in 1987 was 419 (211 offshore spotted and 208 eastern spinner dolphins). The relative frequencies of numbers of dolphins killed per set were quite similar for the three most heavily targeted populations: offshore spotted, eastern spinner and whitebelly spinner dolphins. However, for the less-frequently targeted and differently-behaving common dolphin, higher kill sets occur much more frequently, with problem sets accounting for 41.7% of the total (Figure 2).

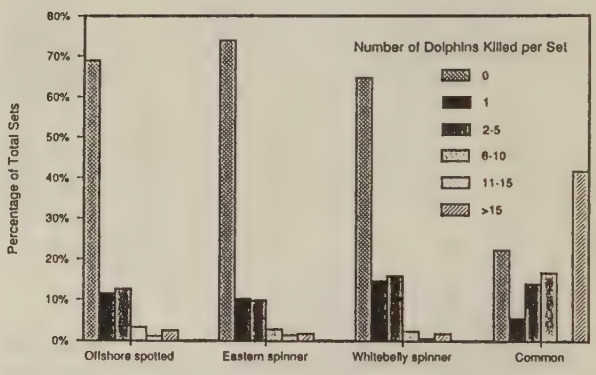


Figure 2. Relative frequencies of dolphin kill-per-set rates by species/stock for observed US tuna purse seiners in the eastern tropical Pacific Ocean, 1987. Species-stock of dolphins captured is determined for each set before the set is completed.

Geographically, areas of high dolphin kill-per-set and kill-per-ton tended to be located along the southern periphery of the general fishing area, an area that traditionally is not heavily fished, and off Baja California (Figures 3A, B). This situation is consistent with those of previous years. The dolphin most often involved in problem sets along the southern periphery was the offshore spotted dolphin; the problem sets off Baja California involved the common dolphin, exclusively.

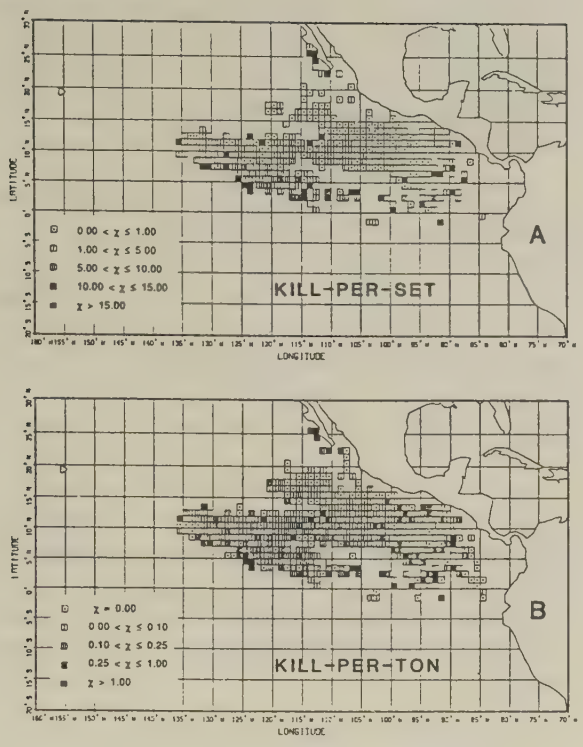


Figure 3. Areal distribution of kill rates by 1° quadrats, for observed US tuna purse seiners in 1987.

(A. Jackson, FTS 893-7048)

## STOCK ASSESSMENT AND FISHERY IMPACT ANALYSIS PROGRAM

### Scientist Receives Award

The Billfish Foundation headquartered in Miami, Florida, awarded Fishery Biologist James L. Squire, Jr., Southwest Fisheries Center, La Jolla, the Foundation's 1989 Conservation Award for Individual Scientific Achievement. The Billfish Foundation is a non-profit organization whose purpose is to promote and encourage research and conservation of billfish worldwide, with the goal of ensuring the future of all billfish species.

Squire was presented an engraved plaque by Chairman of the Board Winthrop P. Rockefeller, at the Foundation's Annual Conservation Awards Meeting held in Ft. Lauderdale, Florida, October 25, 1989.

Squire's research on tunas and billfishes started in the northwest Atlantic in the 1950s. Upon moving to the west coast in 1962, he established the cooperative marlin gamefish tagging program and since then, has worked closely with sport fishermen, angler clubs, and conservationists to make the program a success. The cooperative program has provided information leading to a better understanding of the migratory patterns of billfish in the Pacific. His research also involved determining the effect of environmental changes on the distribution of billfish and other coastal gamefish species, and trends in catch rates of billfish anglers. The annual survey, the International Pacific Billfish Angler Survey, was established in 1969 to obtain data on anglers for his research. (J. Squire, FTS 893-7072)

### Shark Tagging and Tracking Completed

Fishing effort directed at shortfin mako and blue sharks in the Southern California Bight has increased tremendously in the last few years, including development of an experimental longline fishery and an active sport fishery. This increased effort has prompted the need to know more about the southern California shark resource. The Southwest Fisheries Center and California Department of Fish and Game biologists cooperated during four 1-week cruises during August 14-September 15, 1989, to study the stock range and size of both the shortfin mako shark and blue shark resources of southern California.

During the cruises, acoustic telemetry, which has proven useful in studying the short-term horizontal and vertical movements of large pelagic fishes, was used. The objective was to acoustically track shortfin mako sharks, and to tag and release as many other sharks as possible within the area of commercial and recreational fishing activity. Standard sport fishing techniques, chumming with frozen mackerel and sardines, and rod and reel were used to catch specimens. Of 28 shortfin mako sharks caught, three large individuals were selected for tagging with acoustical transmitters. The remainder were tagged with spaghetti tags and released. Tracking of the makos commenced immediately after release, using standard tracking equipment.

The three shortfin mako sharks were tracked for periods from 18 to 25 hours, and resulted in a total of 68 hours tracking time covering 55 nautical miles in the Southern California Bight. Data for both horizontal movements and vertical depth variations were obtained for all tracks (Figures 4 and 5).

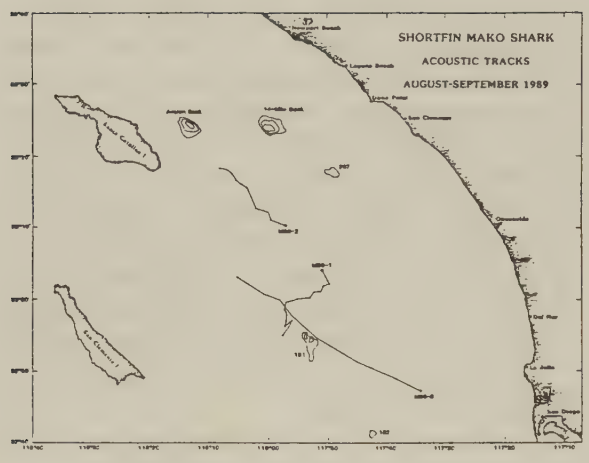


Figure 4. Horizontal movement of three shortfin mako sharks in the Southern California Bight.

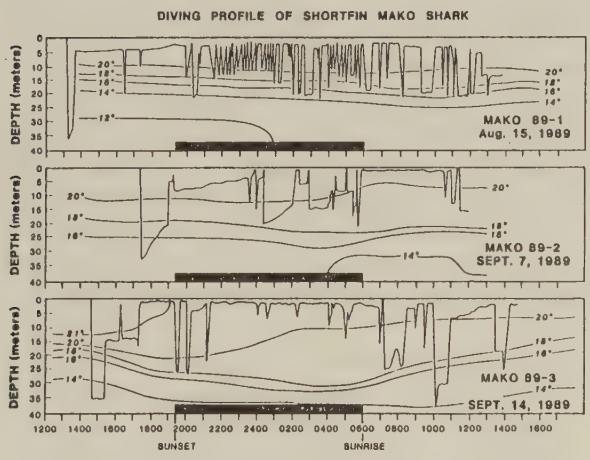


Figure 5. Vertical depth variations of three shortfin mako sharks.

The first fish (M89-1), a 6-foot, 80-pound mako was tagged at 1:00 p.m. It immediately sounded to 35 m, but slowly ascended to 7 m where it remained for several hours. It remained at 7 m until 4:00 p.m. when it made a 5-minute dive to 20 m. From 8:00 p.m. until sunrise it made a total of 32 shallow dives between 3-20 m. These 32 dives were smooth and rhythmic, the deepest and longest dive was to 21 m for 23 minutes. Night hours were the period of least horizontal activity. Between sunrise and the end of the track, it stayed at about 3-5 m between dives.

The second track was of a 5.5-foot mako (M98-2) tagged at 5:30 p.m. It immediately descended to 33 m and gradually began ascending to 19 m during the next 90 minutes. At sunset it rose to between 5-10 m, where it remained until midnight. At midnight, it went to the surface then descended to 18 m and remained at about 15 m until 2:00 a.m. For the next 4 hours, it made several short dives to 10 m and at sunrise it positioned itself between 0-2 m, where it remained for the next 4 hours. This track was terminated after 18 hours to return to port.

The third fish (M98-3), a 5.5-foot, 70-pound mako was tagged at 2:30 p.m. and it too immediately sounded to 33 m. It ascended to 15 m within 1 hour where it remained until 7:30 p.m. At sunset it began a series of short dives but stayed between 0-10 m until after sunrise. It then descended to 22 m for about an hour before rising to the surface. Its deepest dive occurred at 10 a.m. and was to 35 m.

These sharks spent 98% of their time in the mixed layer. The only time they went into or below the thermocline was immediately after tagging and release. Although all of their time was spent in the mixed layer, Table 2 clearly indicates that they spent more daylight time than night time in the 21-30 m range.

Table 2. Summary of percentage of time spent at swimming depths for three shortfin mako sharks tracked off southern California.

| | M89-1 | | M89-2 | | M89-3 | | Combined | | |
|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | Day | Night | Day | Night | Day | Night | Day | Night | Total |
| 0 - 10 | 68.7 | 69.4 | 56.0 | 40.6 | 53.3 | 91.6 | 64 | 70 | 68 |
| 11 - 20 | 18.2 | 29.2 | 9.1 | 58.4 | 23.1 | 2.9 | 18 | 27 | 22 |
| 21 - 30 | 12.0 | 1.2 | 27.9 | 0.8 | 15.3 | 5.2 | 13 | 3 | 8 |
| 31 - 40 | 0.8 | 0 | 6.0 | 0 | 8.0 | 0 | 5 | 0 | 2 |

Besides the mako sharks, 820 blue sharks were caught, tagged with spaghetti tags, and released. The blue sharks were 53% female, 35% male, and 12% unidentified. The mako sharks were all mature with 50% males and 50% females. (D. Holts, FTS 893-7186)

### Scientists Attend FAO Planning Meeting

Pierre Kleiber and Norman Bartoo, SWFC, La Jolla, attended a planning meeting at the South Pacific Commission, New Caledonia, for the purpose of organizing an FAO-sponsored expert consultation on Pacific tunas and interactions between tuna fisheries. This expert consultation will include fishery scientists and fishery officers from various countries throughout the Pacific and beyond, and will be held in early 1991. Richard Shomura, formerly of the SWFC, Honolulu, is the chairman.

The planning meeting was to establish a work plan for tasks that need completing for the consultation. Several working groups were established to review available data, conduct analyses, and prepare material for presentation at the consultation. The chairman of the working group will be contacting other scientists who may be interested in participating.

Bartoo is heading one of nine species working groups. His group will review the state of knowledge of North Pacific albacore in relation to fishery interaction questions. Where possible, the group will evaluate the significance of interactions between the various fleets that exploit that resource. Chairpersons for the other species working groups will be following this format.

Kleiber is in charge of a working group dealing with fishery interaction in general. This group will be in charge of developing and evaluating methodologies for assessing interaction and will help coordinate interaction assessments in the species working groups.

The exact time and place of the consultation has not yet been decided by FAO. However, Noumea, New Caledonia; Shimizu, Japan; and Manila, Philippines are among the locations being considered. (P. Kleiber, FTS 893-7076)

# TIBURON LABORATORY

Tiburon, California

## GROUNDFISH COMMUNITIES INVESTIGATIONS

### Cruise Evaluates Ship-towed Vehicle with Underwater Video Camera for Study of Groundfish Communities

The use of a towed underwater video camera to resolve certain problems with management of west coast groundfish was evaluated by Fishery Biologist Peter Adams of the Groundfish Communities Investigation during an October cruise aboard the chartered vessel *McGaw*. The cruise, led by John Butler of the Southwest Fisheries Center, was a broad evaluation of towed underwater vehicles in studies of west-coast groundfish. Adams' specific goal was to determine whether a video camera can be used to reduce the very large variances present in groundfish population estimates based on trawl surveys. If these variances were reduced, the estimates would provide the fishery-independent basis needed for the age-structure models that are so crucial to groundfish management.

Two major problems developed during this cruise while using a video camera to estimate fish abundances are: 1) difficulties in species identification, and 2) uncertainties about the dimensions of the areas sampled. Both problems resulted from limited camera resolution, excessive ship speed, and a porpoising motion of the vehicle as it moved over the bottom. However, solutions are readily available. Cameras of higher resolution can be used, as can better cables (i. e. fiber-optic), and stronger lighting. The ship can be operated at slower speeds, and performance of the vehicle can be improved by providing more stability and a more accurate means of measuring its distance from the bottom.

Even with these problems, the video record supports various suggestions that have been made to explain why some population estimates based on trawl surveys have such high variances. For example, the high variances in estimates for certain flatfishes have been attributed to habitat differences over the areas sampled by the trawl, in which case the variance can be reduced by improved stratification of the sampling. On the other hand, the high variance in estimates for certain rockfishes has been attributed to life history characteristics, in which case one could not hope that a reasonably increased trawling effort would reduce the variance. Both suggestions were supported by the videotape observations, which show the flatfishes evenly distributed over different bottom types and the rockfishes in large aggregations. The towed vehicle equipped with a video camera, therefore, is judged to have promise of being better than a trawl in getting population estimates of rockfishes, and is worth further study. (P. Adams, FTS 556 0565)

## GROUNDFISH PHYSIOLOGICAL ECOLOGY INVESTIGATIONS

Staff members of the GPEI have been working on a number of manuscripts during the last 2 months that report results of studies done on the yellowtail rockfish (*Sebastes flavidus*). One of these is a paper proposed by Jeannette Whipple, to be coauthored by David Hinton and M. S. Okihiro from the Department of Pathology, School of Veterinary Medicine, Univer-

sity of California, Davis. This paper will be on the occurrence of chromatophoromas (melanophoromas, characterized by presence of melanin pigment) in yellowtail rockfish off the west coast of the United States. The paper will include a description of these tumors, together with prevalence in different populations, frequency of occurrence in different ages and sexes, pathological effects, relationship to fish condition and reproduction, and potential significance on a population level. (J. Whipple, FTS 556-0569)

Dr. Jeannette Whipple gave a lecture to the Environmental Biology Class, College of Natural Resources, UC Berkeley, on October 26. The lecture was on San Francisco Bay Estuarine Pollution.

Dr. Maxwell B. Eldridge presented a seminar titled "Reproductive traits of yellowtail rockfish, *Sebastes flavidus*" at Humboldt State University, Arcata, California, on October 18. The seminar was part of the HSU fall seminar series.

## GROUNDFISH ANALYSIS INVESTIGATIONS

### Seasonal Shifts in the Spatial Distributions of Juvenile Rockfish Studied

One of the goals of the rockfish recruitment program is to forecast future recruitments of commercial rockfishes to the west coast groundfish fishery. To do so requires an understanding of how oceanographic and early life history events interact to mold survival of larvae and pelagic stage juveniles. Members of the genus *Sebastes* are viviparous, with parturition of many species occurring from December to March. Larvae grow and metamorphose into pelagic juveniles after roughly one month. They can be found in offshore waters until at least late June, at which time many species appear and settle in nearshore demersal habitats. One of the mysteries of this life history pattern is how and when the onshore movements occur.

The rockfish recruitment program has surveyed the abundance of pelagic juveniles annually since 1983. However, starting in 1986, standard stations have been sampled with a large midwater trawl during geographically and seasonally stratified "sweeps" of the study area between Point Sur and Point Reyes (Figure 1). From these data it is possible to look for seasonal shifts in the spatial distribution of pelagic stage juveniles that might in some way correspond to onshore movements prior to settling.

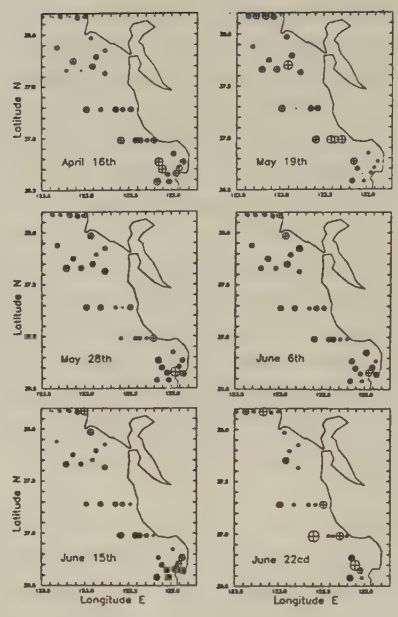


Figure 1. Seasonal progression of spatial distributions of pelagic juvenile rockfishes based on sampling at standard stations (1986-89).

However, results show (Figure 1) no obvious onshore shifts in the spatial distribution of pelagic juveniles from mid-April to the latter part of June. Note that the sizes of the circles in the figure are proportional to standard Z-scores calculated at each of our regular sampling stations. To compute these values, standard scores at each station occupied were calculated from the mean and variance of the logarithm of total juvenile *Sebastes* spp. catch taken during each sweep. This effectively standardizes for differences in overall levels of abundance from sweep-to-sweep and from year-to-year. These were then averaged to produce the data summarized in the figure.

There are a number of possible reasons why no pattern of onshore movement is evident in the figure. All relate to the notion that fish may be responding and moving according to some factor in the environment that is not tightly correlated with calendar date. For example, the birthdate distributions of these fishes, particularly *S. paucispinis, S. entomelas, S. jordani, S. goodei*, and *S. flavidus*, demonstrate interannual shifts of as much as 3 months. Growth rates also vary. Either occurrence may cause the timing of the onshore movement to shift considerably. Likewise, the oceanographic environment is certain to change from year-to-year. Efforts are now underway to evaluate the importance of these factors in relation to changes in the spatial distribution of pelagic juvenile rockfishes. (S. Ralston, FTS 556-0565)

# INFORMATION TECHNOLOGY SERVICES

### SWFC Local Area Network Progress and Plans

A prototype 3COM Local Area Network (LAN) was installed at the La Jolla Laboratory in June 1988. The size and scope of the LAN were limited in order to reduce initial investment, complexity, and risk. The prototype configuration included a single 80186 network server, three cabling segments, eight PC workstations, one shared printer, wordprocessing software, eMAIL, and an inter- network router for the eMAIL service.

On the basis of a successful prototype, it was decided to expand the 3COM LAN. For the time being the LAN will retain its mix of general purpose offerings such as wordprocessing, file and device sharing, eMAIL, etc. The current thrust for LAN expansion is to increase the user base.

The network now supports: two 3COM network servers with 390 Mb of shared disk, a single PC communications server, two shared Hewlitt Packard Laserjet printers, many different "private" or locally attached printers, four networked shareable modems, a magnetic tape backup subsystem, WordPerfect 5.0 (36 user license), WordStar 4.0 (11 user license), eMAIL, Procomm 2.4.2 and Smartcom II LAN version, and 3+ROUTE for transparent eMAIL delivery between 3COM networks in NMFS Silver Springs Headquarters, the Auke Bay Laboratory, and the Honolulu Laboratory. The network operating system has been upgraded from 3+Share 1.2 to 1.3.1. Twenty-six PC workstations are currently attached to the La Jolla LAN.

Full system backups of server disk are now run on a weekly basis with incremental backups run four nights per week. Certain of these backup sets are secured offsite in a magnetic media storage vault. Disk restorations of files stored within user's "home" directories are routine.

Network cabling has been expanded and now includes seven "hot" segments. Many PCs within the laboratory may now connect to the LAN with minimal additional expense. New users are expected to pay costs of LAN adaptor cards and PC workstations. ITS will bear the cost of operating the LAN, and pay cabling costs to add new cabling "drops" to connect users' PCs. ITS expects to add an additional 10-15 new users during the remainder of the current fiscal year. Users interested in LAN connection should contact ITS, Al Coan, or Rich Charter in order to be put in queue.

Over the period of the next year ITS plans to evaluate (possibly install) new products providing better communications with remote non-3COM systems. In particular, the new LAN version of Procomm Plus will be tried on the La Jolla network. This package, when run with Asynchronous Communications Server software, enables users to link their PCs to networked modems and asynchronous ports (i.e. UCSD LAN terminal services ports). It offers an easy-to-use Kermit file transfer protocol which is presently unavailable within our present LAN communications package (SmartCom II). Products for conserving and better managing PC workstation memory, as well as LAN spreadsheet programs are also being evaluated. (F. Ralston, FTS 893-7062)

# EVENTS

### La Jolla Laboratory Celebrates 25th Anniversary

On Saturday October 28, the public, honored guests and past and present employees of the Southwest Fisheries Center gathered from far and wide to celebrate the 25th Anniversary and rededication of the Southwest Fisheries Center's La Jolla Laboratory, and to tour a series of special Open House exhibits describing the history and current research of the Center.

Dr. John Knauss, Under Secretary of Oceans and Atmosphere, was one of the speakers at the rededication ceremony. Other speakers were Director-Emeritus of Scripps Institution of Oceanography, Dr. Roger Revelle; Dr. Edward Frieman, Director, Scripps Institution of Oceanography; Frank Hope, Jr., son of the architect who designed the buildings; Donald Johnson, formerly Regional Director of NMFS' Northwest Region; E. C. Fullerton, NMFS' Southwest Regional Director; Al Petrovich, Chief, Marine Resources Branch, California Department of Fish and Game; and The Honorable Bob Wilson of San Diego. Dr. Izadore Barrett, Director of Science and Research for the Southwest Region, was Master of Ceremonies.

Figure 1. Dr. John Knauss speaks at rededication ceremony. Others on grandstand from left to right: Mr. Donald Johnson, Mr. E. Charles Fullerton, Dr. Izadore Barrett, Dr. Roger Revelle, Dr. Edward Frieman, Honorable Bob Wilson, and Mr. Frank Hope, Jr.

The 25-year-old buildings that make up the La Jolla facility looked as impressive as ever on rededication day, poised atop the cliff above the vast expanse of the Pacific Ocean. Visitors admired the view and toured NMFS exhibits illustrating research on marine mammals, tuna and billfish, Antarctic studies and other projects. Also participating in the Open House were other NOAA agencies such as the National Weather Service, the NOAA Corps, NOAA Corps Operations, and the National Environmental Satellite Data Information Service.

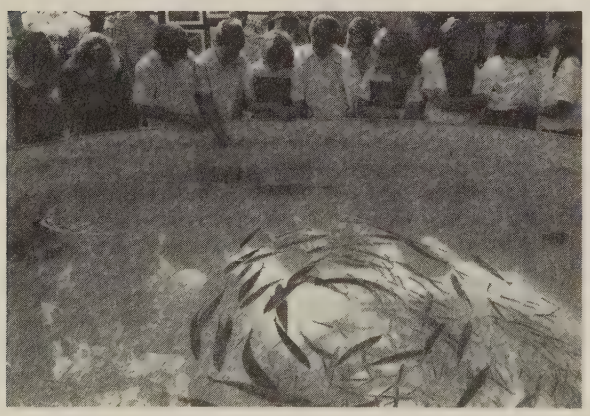

Figure 2. A live fish display was one of the 25 exhibits at the La Jolla Laboratory's Open House. In the pool were sardines, anchovies, mackerel, flatfish, sheepshead, horn shark and others.

The complex was originally dedicated in 1964, when the Center was known as the Fishery Oceanography Center under the U.S. Department of Interior's Bureau of Commercial Fisheries. At that time, there were two main research groups at the Center, one studying causes of the decline in Pacific sardines along the West Coast, and another group that conducted research on commercially- important tunas in the Pacific Ocean. In 1970, marine research within the Bureau of Commercial Fisheries transferred to the then newly-created NOAA within the Department of Commerce. Today most of the scientific research at the Center is devoted to supporting Fishery Management Councils and the Marine Mammal Protection Act, surveying fish and marine mammal resources within NOAA's Southwest Region, and studying international resources such as migratory tunas and marine life of the Antarctic.

Figure 3. Marine mammal and tuna exhibits at the Open House.

Former Special Assistant to the Director, Lillian Vlymen, prepared a special historical document in honor of the 25th Anniversary celebration entitled "The First 25 Years", which was published as NOAA Technical Memorandum NOAA-TM-NMFS-SWFC-134. (S. Smith, FTS 893-7070)

## PUBLISHED

Becker, Brenda L., Robert J. Morrow, and Julie K. Leialoha. 1989. Censuses and inter-atoll movements of the Hawaiian monk seal on Laysan Island, 1985. U.S. Dep. Commer., NOAA Tech. Memo. NOAA-TM-NMFS-SWFC-135, 25 p.

Research on the Laysan Island population of the endangered Hawaiian monk seal, *Monachus schauinslandi*, was conducted from 2 March to 30 November 1985.

Census totals excluding pups ranged from 76 to 147 ($\bar{x}$ = 101.6), an average increase of nearly 20 animals from the 1984 census results. Overall monthly haul- out distribution for all seals showed highest use in the north ecological unit followed by the west unit. Relatively few animals hauled out in the eastern and southern portions of the island. Interatoll movement of nine seals was documented, resulting in a net increase of three animals to the Laysan Island population.

Boehlert, G. W. 1989. Marine populations: An essay on population biology and speciation, by Michael Sinclair. Limnol. Oceanogr., Book Review, 34:968-969.

Hobson, E. S. and D. H. Howard. 1989. Mass strandings of juvenile shortbelly rockfish and Pacific hake along the coast of northern California. Calif. Fish Game 75: 165-183.

Carcasses of young of the year (YOY) juvenile shortbelly rockfish and Pacific hake littered the shores of northern California during June 1988, causing much concern among local inhabitants. Studies by personnel of the Tiburon laboratory indicate that these and similar strandings during recent years have resulted from a combination of strong recruitment and shoreward surface transport under unseasonal southerly winds.

MacCall, Alec D. 1989. Against marine fish hatcheries. Calif. Coop. Oceanic Fish. Invest. Rep. 30:46-48.

Perrin, William F., Nobuyuki Miyazaki and Toshio Kasuya. 1989. A dwarf form of the spinner dolphin (*Stenella longirostris*) from Thailand. Mar. Mammal Sci. 5(3):213-227.

A very small form of the spinner dolphin has been found to inhabit the Gulf of Thailand. Ten specimens taken incidentally in a local shrimp fishery differ from specimens of this species collected elsewhere in body size and shape, skull size and shape, number of teeth and numbers of thoracic and lumbar vertebrae. Four cranially adult males were 129-137 cm long, well below the ranges for the Indian Ocean, western Pacific, central Pacific, eastern Pacific and Atlantic. The skull is also very small. Tooth counts and vertebral counts average lower than in other series. The color pattern is not significantly different from that of spinner dolphins in the central and western Pacific, Atlantic and Indian Oceans but differs from that of the small eastern spinner of the eastern Pacific. The Gulf of Thailand specimens are morphologically separable from all other specimens but it is to be expected that when larger samples are available there will be some overlap. The dwarf form may overlap in body and skull size with small spinner dolphins taken incidentally in a gillnet fishery for sharks off northern Australia. The geographic range of the dwarf spinner may be restricted. The size and status of the population and the impact of the shrimp fishery are unknown and should be investigated. The dwarf spinner may have an ecology different from that of other spinners, feeding mainly on reef-associated and benthic organisms rather than mesopelagic animals.

Seki, Michael P., and Craig S. Harrison. 1989. The feeding ecology of two subtropical seabird species at French Frigate Shoals, Hawaii. Bull. Mar. Sci. 45:52-67.

Regurgitated food samples from black noddy, *Anous minutus*, and red-footed booby, *Sula sula*, were collected and analyzed from French Frigate Shoals, Hawaii. Eighteen families of fishes, three families of cephalopods, and miscellaneous crustaceans were found in 396 black noddy samples. The most common prey were identified as fishes belonging to the families Synodontidae, Mullidae, and Microdesmidae and as the cephalopod family Ommastrephidae. Twenty-two families of fishes, primarily the Exocoetidae, Carangidae, and Mullidae, along with ommastrephid squids were found in the 456 red-footed booby samples. Our results suggest that these two species of seabirds are apex, opportunistic predators. Seasonal analyses reflect the variation of prey availability over the course of a year and lend support to the notion that this variation is a controlling factor in the timing of the species' breeding. The relationship between the trophic ecology of the seabirds and a tropical fishery is discussed.

Squires, Dale, Samuel F. Herrick, Jr. and James Hastie. 1989. Integration of Japanese and United States sablefish markets. Fish. Bull., U.S. 87(2):341-351.

As United States sablefish production becomes more tightly interwoven with Japanese markets, the U.S. sablefish fleet could become more vulnerable to changes in Japanese market conditions and government policies, and U.S. policies would have to be formulated with an eye on Japanese conditions. If U.S. ex-vessel and Japanese markets are integrated by prices, then price information transmitted from the Japanese market affects the behavior of the U.S. markets, while in turn, if the markets are not price integrated, U.S. market behavior is independent of price movements in Japan. To assess this likely market integration, this paper examines the price integration of the Pacific coast and Alaska's fixed gear ex-vessel markets and the Tokyo central wholesale market over 1989-1986. The Pacific coast market is found to be segmented from the Tokyo market while a form of price integration exists between the Tokyo and Alaska markets. The paper concludes with a number of implications for policies in both the United States and Japan.

## Approved by Science and Research Director, SWR

Balazs, George H. New initiatives to study sea turtles in the eastern Pacific. For publication in the Marine Turtle Newsletter.

Balazs, George H. Tumors continue to spread in Hawaiian green turtles. For publication in the Hawaii Wildlife Newsletter.

Boehlert, George W. Fisheries research in the central and western Pacific in the 1990's. For publication in the Forum Fisheries Agency, Tenth Anniversary Conference on Management and Development Strategies in South Pacific Fisheries.

Boehlert, George W. Review of the NMFS fisheries research activities in the central and western Pacific. For publication in the Forum Fisheries Agency, Tenth Anniversary Conference on Management and Development Strategies in South Pacific Fisheries.

Eldridge, Maxwell B., Jeannette A. Whipple, Michael J. Bowers, Brian M. Jarvis and Jordan Gold. Reproductive performances of yellowtail rockfish, *Sebastes flavidus*. For consideration for publication in Environmental Biology of Fishes.

Everson, Alan R., Robert A. Skillman and Jeffrey J. Polovina. Evaluation of rectangular and circular escape vents in the Northwestern Hawaiian Islands lobster fishery. For consideration for publication in North American Journal of Fisheries Management.

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Reilly, S. B. and V. G. Thayer. Blue whale (*Balaenoptera musculus*) distribution in the eastern tropical Pacific. For consideration for publication in Marine Mammal Science.

Somerton, David A. Detecting differences in fish diets. For consideration for publication in Fishery Bulletin, U.S.

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U.S. National Marine Fisheries Service [George W. Boehlert]. Fisheries research in the central and western Pacific in the 1990's. Forum Fisheries Agency, Tenth Anniversary Conference on Management and Development Strategies in South Pacific Fisheries.

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Kawamoto, Kurt E., Russell Y. Ito, Raymond P. Clarke, and Allison A. Chun. 1989. Status of the tuna longline fishery in Hawaii, 1987-88. SWFC Admin. Rep., Honolulu, H-89-10, 34 p.

Peixun, Chen and Hua Yuanyu. 1989. Projected impacts of the Three Gorges Dam on the baiji and needs for conservation of the species. Translated by C. H. Perrin and edited by W. F. Perrin. SWFC Admin. Rep., La Jolla, LJ-89-23, 24 p.

Bartoo, Norman and Yoh Watanabe. 1989. Report of the Eleventh North Pacific Albacore Workshop, May 18-19, 1989, La Jolla, California USA. SWFC Admin. Rep., La Jolla, LJ-89-24, 17 p.

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